

Note: The following language REPLACES its respective language in the version of the NJTA 2004 Standard Supplementary Specifications which existed prior to the issuance of this DCA.

**NOTE TO DESIGNERS:**

The following section is "non-standard". It shall be numbered consecutively in the supplementary specifications starting with number 428 regardless of the number shown. For example, if you want to use section 433 – Prefabricated Modular (PM) Walls, but no other non-standard section, it shall be renumbered 428. If another non-standard section is required, it shall be numbered 429, ff.

Designers shall consult the New Jersey Turnpike Procedures and Design Manuals for parameters for site investigation, geotechnical and structure design and plan presentation and vendor coordination requirements for Prefabricated Modular (PM) Walls.

Designers shall select wall systems to be included in this contract from the list of systems in Section 433.02 (A) hereinafter. Only wall systems participating in the design consultation as described in the Procedures Manual shall be included in the contract.

## **SECTION 433 - PREFABRICATED MODULAR WALLS (PMW)**

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### **433.01 DESCRIPTION**

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This work shall include the design and construction of prefabricated modular wall (PMW) structures composed of precast concrete modular units, cast-in-place and precast parapets, moment slabs, copings, concrete leveling pads/footings, joint materials, backfill and porous fill materials, and all other appurtenant items of construction within the Common Structure Volume as shown on the Plans, included as part of the approved Prefabricated Modular Wall System, or as specified herein.

Design and construction of precast modular walls shall be in accordance with AASHTO LRFD Design and Construction Specifications with modifications herein and in accordance with the NJTA Design Manual wherein:

- Load Factor Design (LFD): Internal Strength and Stability for Barrier Parapet and Moment Slab System
- Allowable Stress Design (ASD): External Stability for Moment Slab

All other labor, materials, equipment, and tools as required to prepare the site, construct the leveling pad, construct the wall, place and compact the pervious backfill and porous fill, and construct the coping and traffic barrier shall be supplied by the Contractor.

### **433.02 MATERIALS**

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Materials shall conform to the current editions of AASHTO LRFD Bridge Design Specifications with Interims and AASHTO LRFD Bridge Construction Specifications with Interims with modifications herein and the provisions of the wall system selected for construction in this contract.

#### **(A) Prefabricated Modular Wall Systems**

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The following Prefabricated Modular Wall Systems are acceptable for use on this Project:

Doublewal  
Doublewal Corporation  
7 West Main Street  
Plainville, CT 06062  
Phone: (860)-793-0295  
Fax: (860)-793-2119

T-Wall  
The Neel Company  
8328-D Traford Lane  
Springfield, VA 22152  
Phone: (703) 913-7858  
Fax: (703) 913-7859

Dura-Hold\* and Dura-Hold II\*  
Dura-Sales Corporation  
2481 Bull Creek Road  
Tarentum, PA 15084  
Phone: (724) 224-7700  
Fax: (724) 226-8888

\* Height limitation of fifteen (15) feet as measured from the underside of the bottom-most wall unit for any level run of constructed wall.

Selection of only one (1) wall system will be permitted for use on this Contract. The Contractor shall make its own arrangements to purchase the materials and services from one of the manufacturers of a permissible Prefabricated Modular Wall Systems listed herein.

An on-site technical representative from the selected PM Wall Systems manufacturer shall be present to assist and instruct during the installation of the first two-module courses, as a minimum.

Except as may be modified within this Section, all applicable provisions of Sections 400 and 900 shall apply in furnishing MSE Wall Systems.

#### 1. Concrete Modular Units

Prefabricated modular units shall be Class P, cured by any one of the methods specified in the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products (MNL-116).

If steam curing is used however, the applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 °F or lower, and shall be delayed for a period of three hours when the air temperature is 50 °F or higher. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature. The curing period shall be maintained at 143 °F +/- 9 °F for a period of 12 hours.

Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should either test cylinder indicate the precast units have not achieved a compressive strength of 4,000 psi or greater, the precast units shall be cured further until the required strength is achieved.

2. Appurtenances

Filler for joints for footings shall conform to Subsection 907.01.

Filler for front face horizontal joints between units shall be closed-cell polyethylene foam backer rod conforming to AASHTO M 153, Type 1.

Filter fabric placed inside the units over all vertical joints in the front face shall be 12 inches wide and conform to Subsection 923.21.

Coarse aggregate layer shall be material obtained from an approved commercial source and processed into stone size ASTM C33, size No. 67.

Weep holes, where shown on the Plans, shall be constructed in the manner and at the locations required. Ports or vents for equalizing hydrostatic pressure shall be placed below low water, if shown. Forms for weep holes through concrete shall be 4 inch clay pipe, polyvinyl chloride, transite, or unreinforced concrete drain pipe.

Underdrains, where shown on the Plans, shall conform to Section 501.

**(B) Backfill Material**

Backfill materials, pervious backfill, porous fill and retained backfill, for use in the Common Structure Volume may be procured from off-site sources or may be sourced from on-site borrow excavation. Where specific pervious backfill materials or material gradation designations are noted on the Plans, no substitutions will be permitted for those materials.

Pervious backfill material used within the PMW units shall be reasonably free from deleterious materials, shale or poor durability particles and shall conform to the properties specified by the wall manufacturer. Unless otherwise specified these materials shall meet the following gradation limits as determined by AASHTO T 27:

Soil Aggregate

Sieve Size	Percent Passing
3 inches	100
No.200	0-15

The Contractor shall determine the optimum moisture content and maximum dry density of the backfill in accordance with AASHTO T 99 unless otherwise specified by the designer.

Porous fill shall be used behind all units and shall conform to Section 901.01

The frequency of sampling and testing of backfill material shall be performed at least once for every 1000 cubic yards of material placed for all tests denoted above. A minimum of two samples per structure shall be taken. Additional samples shall be taken whenever the appearance or behavior of the material changes and as directed.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the backfill material complies with this Section.

A copy of all test results performed by the Contractor which are necessary to ensure compliance with these Specifications shall also be furnished.

### **433.03      METHODS OF CONSTRUCTION**

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Methods of construction shall conform to the current editions of AASHTO LRFD Bridge Design Specifications with Interims and AASHTO LRFD Bridge Construction Specifications with Interims with modifications herein and the provisions of the permitted wall system selected for construction in this contract.

#### **A)      Fabrication.**

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The units shall be cast in steel forms and in a manner that will ensure the production of uniform units. The transporting, placement, and compaction of concrete shall be by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcement steel from its proper position in the form. The units may be removed from the forms at any time when removal can be accomplished without damage to the panel. Unless otherwise indicated on the Plans or elsewhere in the specifications, the finish for the front face shall be an ordinary surface finish conforming to Subsection 401.17. The rear face shall have a uniform surface finish free of open pockets of aggregate.

The name of the manufacturer, name of project, date of manufacture, mark numbers, and type of unit in accordance with the approved erection drawings shall be clearly marked in the inside face of each unit.

#### **(B)      Inspection and Rejection.**

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The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer prior to shipment. Individual units will be rejected because of any of the following:

- (1)      Variations in the exposed face that substantially deviate in texture.
- (2)      Dimensions not conforming to the following tolerances:
  - (a)      Face of panel, length or height: plus or minus 3/16 inch.
  - (b)      Deviation from square when measured on diagonal: 5/16 inch for units up to 10 feet wide, 13/16 inch for larger units.

- (3) Honeycombed or open texture not properly repaired.
- (4) Defects which would affect the structural integrity of the unit.
- (5) Defects in the physical characteristics of the concrete units, such as:
  - (a) Stained front face due to excess form oil or other reasons.
  - (b) Signs of aggregate segregation.
  - (c) Broken or cracked corners.
  - (d) Lifting inserts not usable.
  - (e) Exposed reinforcing steel.
  - (f) Cracks at the PVC pipe or pin.
  - (g) Insufficient concrete compressive strength.
  - (h) Deviation from flatness of exposed surface in excess of 1/8 inch per 5 feet

An additional inspection shall be made prior to erection to determine any damage which may have occurred during storage.

The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer at no additional cost to the Authority.

Repair to concrete surfaces which will be exposed to view after completion or construction shall be approved.

**(C) Shipment.**

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The precast units shall not be shipped until the minimum 28-day compressive strength has been attained and a minimum of 72 hours after fabrication and shall meet the acceptance criteria in Subsection 402.10.

Handling devices, as required, shall be galvanized and shall be provided for the purpose of handling and placing. Care shall be taken during storage, transporting, hoisting, and handling of all units to prevent cracking or damage.

Units damaged by improper storing, transporting, or handling shall be replaced or repaired.

**(D) Installation.**

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The foundation bed for the structure shall be approved by the Engineer before erection is started. Prior to wall construction, the foundation bed shall be compacted with a vibratory compactor. Any foundation soils found to be unsuitable shall be removed and replaced with coarse aggregate.

At each unit foundation level, either a precast or cast-in-place footing and/or a leveling pad shall be provided. The footings shall be Class B

concrete, be given a wood float finish, and shall reach a compressive strength of 2,000 psi before placement of wall modules. The completed footing surface shall be constructed in accordance with grades and cross slopes shown on Plans. When tested with a straightedge, the surface shall not vary more than 1/8 inch in 10 feet.

The units shall be installed in accordance with the manufacturer's recommendations. Special care shall be taken in setting the bottom course of units to true line and grade. While erecting each subsequent course, line, and grade shall be examined, and deviations shall be corrected to prevent cumulative inaccuracies in alignment. Joint filler and rubber pads shall be installed. Joints at corners or angle points shall be closed.

Prefabricated modular wall units shall be filled one course at a time, with pervious structure backfill. Units 4 feet or less in height shall be filled in one layer and then thoroughly compacted with a vibratory tamping device. Units which are more than 4 feet in height shall be filled in two approximately equal layers and thoroughly compacted after each layer is placed.

Backfill shall be compacted to 95 percent of maximum density as determined by AASHTO T 99, Method C.

Porous fill shall be used behind all units and shall be free from organic or otherwise deleterious material. Unless otherwise noted on the working drawings, backfill material, in the structure volume behind the wall, shall conform to Subsection 433.02.

When erecting a battered wall, placement of backfill behind the wall shall closely follow erection of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last erected course exceed 6 feet.

All units above the first course shall interlock with the lower courses. Vertical joint openings on the wall's front face shall not exceed 13/16 inch.

The front face vertical joints shall have 1 foot wide strips of filter fabric behind each joint starting 2 feet below grade.

The overall vertical alignment tolerance, or plumbness or line of batter, from top to bottom of the structure, shall not exceed 1/2 inch per 10 foot of wall height.

Deviation from horizontal alignment shall not exceed 3/4 inch.

Vertical and horizontal alignment tolerance, or plumbness/batter should not exceed 3/4 in. when measured with a 10 ft. straight edge on a selected wall section.

The maximum allowable offset between any two units should not exceed  $\frac{3}{4}$  inch.

**(E) Construction Stormwater Management**

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The Contractor shall slope the last placed level of backfill away from the wall facing to rapidly direct runoff of rainwater away from the wall face. Surface runoff shall not be allowed to enter the wall construction site from adjacent areas.

**433.04 WORKING DRAWINGS**

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Working drawings shall be prepared and submitted in accordance with the requirements specified under Subsection 104.08. At a minimum, working drawings shall include the following:

- (A) Design calculations, signed and sealed by a Professional Engineer licensed in the State of New Jersey, in conformance to current edition of AASHTO LRFD Bridge Design and Construction Specifications with Interims with modifications herein and the provisions of the approved wall system selected for construction in this contract. PM walls shall be designed for a 75 year design life. PM walls which support embankments under bridge abutments shall be designed for a 100 year design life.
- (B) General notes, design parameters, soil characteristics of backfill materials, and factors of safety and/or load and resistance factors.
- (C) An elevation view of the wall showing:
  - (1) Elevations along the top of the wall, at beginning and end of wall, at 25 foot intervals, at changes in grade, at changes in Common Structure Volume Limits; and at prefabricated modular unit joints where indicative of wall geometry.
  - (2) Elevations and step locations for leveling pads and/or footings.
  - (3) The location of the final ground line.
  - (4) Number and type of prefabricated modular units.
  - (5) A numbered modular unit layout for fabrication and erection purposes.
  - (6) Designation of breaks in vertical alignments and elevations.
  - (7) Locations and elevations/inverts of any utilities or drainage which passes through the retaining wall or the Common Structure Volume.
- (D) A plan view of the wall showing:
  - (1) The offset from the construction baseline to the face of prefabricated wall units at all changes in horizontal alignment.
  - (2) ROW limits and their relationship to the wall with offsets and stations to wall corners and ends.
  - (3) Locations of piles, drilled shafts, noise walls, sign structures, or other appurtenant items which are supported by the wall or its parapet/coping.
  - (4) Locations and alignments of any utilities or drainage which passes through the retaining wall or the Common Structure Volume.
  - (5) The offset from the construction baseline to limits of Common Structure Volumes at all changes in horizontal alignment and offsets of CSV limits.
- (E) Typical sections of walls showing:

- (1) Limits of cut and fill work.
  - (2) Limits of pervious backfill, porous fill, retained backfill and drainage materials.
  - (3) Limits of Common Structure Volume and associated appurtenant items such as drainage features.
  - (4) Location of final ground lines.
- (F) Prefabricated modular unit details for all unit types, including special modules, with all dimensions necessary to construct the units with locations in the member of all appurtenant items such as reinforcement steel, and lifting devices.
- (G) Details for footings, leveling pads and footing or leveling pad step details, where required.
- (H) Details for precast barriers, copings, connections to all appurtenant items such as railings, fences, lighting standards, and noise barriers.
- (I) Details for wall construction to accommodate any obstructions such as piles, drilled shafts, utilities, highway lighting systems, and drainage structures.
- (J) Details for any cast in place elements with all dimensions necessary to construct the elements with locations in the member of all appurtenant items such as reinforcement steel.
- (K) Detail for any architectural treatments such as facing finish, texture, and color.
- (L) The manufacturer's installation manual including sequence of construction. Two bound copies of the approved manual shall be furnished to the Engineer.

#### **433.05**

#### **SUBSTITUTIONS**

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One wall system shall be selected by the Contractor and only that wall system shall be constructed in this contract.

Wherever requirements for wall components, proprietary components, or methods of construction are specified, it is intended to establish a standard of quality and shall not be interpreted to preclude substitutions by Contractors subject to conditions given hereinafter.

Substitution will be considered when such proposed substitution equals or exceeds that specified with respect to quality, workmanship, service, maintenance, economy, reliability of operation, code compliance and aesthetics.

When the Contractor requests substitution, it shall first thoroughly investigate its proposed substitution and certify to the Engineer, in writing, that said proposed substitution is equal to that specified. It shall include with said certification all required data, samples, reports and tests to substantiate its findings. The Engineer will decide if such substitution is equal to that specified; and if found to be so, may then be approved. The Engineer's decision will be final and binding to all parties.

Where proposed substitution(s) require modification to the Common Structure Volume as shown on the Plans, the Contractor shall quantify all impacts and adjustments to affected item quantities such as but not limited to excavation, backfill, and sheeting and the Project schedule as a part of its substitution



request. Additional costs which arise from quantity or schedule impacts of the substitution shall be borne solely by the Contractor. Approval of the disposition of the pay limits and quantities to accommodate the substitution shall be part and parcel to the approval of the substitution.

Approved substitutions shall be at no additional cost to the Authority. Rejection of a requested substitution shall not be considered as a basis for a claim against the Authority.

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## **433.06 MEASUREMENT**

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Prefabricated Modular Walls will be measured by the total number of square feet of retaining wall face area. The area measured will be the product of the average vertical height between final rear face (upper) and front face (lower) ground lines and the total lengths of the wall as given on the Plans. Within the Common Structure Volume or except as may otherwise be provided for, no quantity other than the wall area will be measured for payment.

### Common Structure Volume

The Common Structure Volume (CSV) is the volume that contains all components of all retaining wall systems considered for construction at a given site. The limits of the CSV are defined as:

- End Limit Planes: Vertical planes, normal or radial to the wall alignment, at begin and end stations of the wall system.
- Forward Limit Plane: Vertical plane(s) two feet or other designated distance shown on the Plans forward of the fascia. The fascia is defined as the forward limit of wall coping or barrier parapet face, wall panel or unit face or other physical feature as shown on the plans
- Rear Limit Plane: Vertical plane(s) at the rear limits of the Select Backfill. For the purposes of defining the CSV, this limit will be located parallel to the Forward Limit Plane and at minimum distance of 70% of the average vertical dimension between the Bottom Limit Plane and the Top Limit Plane, plus one (1) foot and will include any porous fill, all wall appurtenances such as drainage systems, pertinent retained fill and any work to be included in the wall pay item.
- Bottom Limit Plane: Horizontal Plane(s) at the lower elevations of the wall to include the leveling pad(s)/footing(s), the undersides of the select backfill or modular units and excavations required for the construction of the select backfill or modular units, extending between the Forward and Rear Limit Planes of the CSV.
- Top Limit Plane: Plane(s) defining the configuration (slope, roadway, pavement box, etc) at the top of the wall extending between the forward and rear limits of the CSV. Where finished grade of an MSE wall is defined by a pavement system, the CSV Top Limit Plane shall be defined as the underside of the pavement system subgrade material as noted in the Plans.

Unless otherwise noted in the Plans or Specifications, all components of the wall system and all components, elements or appurtenances , such as copings, parapets, barriers, moment slabs, wall underdrains, etc., founded or located within the CSV or attached to any component of the wall system within the CSV shall be included in the CSV.

**433.07      PAYMENT**

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Payment will be made under:

<i>PAY ITEM</i>	<i>PAY UNIT</i>
Prefabricated Modular Walls .....	Square Foot

No additional payment will be made for Substitutions under Subsection 433.05.

No additional payment will be made for costs resulting from submission, approval or rejection of Substitutions under Subsection 433.05.

Payment for electrical items will be made in accordance with Division 600 unless otherwise noted on the Plans.

Note: The following language is ADDED to the version of the NJTA 2004 Standard Supplementary Specifications which existed prior to the issuance of this DCA.

**NOTE TO DESIGNERS:**

The following section is “non-standard”. It shall be numbered consecutively in the supplementary specifications starting with number 428 regardless of the number shown. For example, if you want to use section 440 – Alternate Retaining Wall Designs, but no other non-standard section, it shall be renumbered 428. If another non-standard section is required, it shall be numbered 429, ff.

Designers shall consult the New Jersey Turnpike Procedures and Design Manuals for parameters for site investigation, geotechnical and structure design and plan presentation and vendor coordination requirements for Alternate Retaining Walls.

Designers shall select wall systems to be included in this contract from the list of systems in Section 432.02 (A) and 433.02 (A). Only wall systems participating in the design consultation as described in the Procedures Manual shall be included in the contract.

Where alternate retaining wall and/or abutment designs, both mechanically stabilized earth and prefabricated modular, are permitted on the plans, the item for these walls/abutments is simply “Retaining Wall No. \_\_\_\_” or “Abutment Wall No. \_\_\_\_” and shall be identified as such in the Plans, Specifications and Estimates.

Standard Supplementary Specifications Sections 432 and 433, “Mechanically Stabilized Earth Walls” and “Prefabricated Modular Walls”, respectively, shall be included in the project special provisions with pay items referenced to this section.

## **SECTION 440 – ALTERNATE RETAINING WALL DESIGNS**

### **440.01**

#### **DESCRIPTION**

The provisions of this Section apply to construction at various locations on the Plans where alternate retaining wall designs are permitted. The Plans offer the Contractor the option of constructing alternate types of proprietary retaining walls, either Mechanically Stabilized Embankment Retaining Walls or Prefabricated Modular Retaining Walls, at each site.

Substitute wall types may be submitted for approval in accordance with Subsections 432.05 and 433.05 of the (Standard) Supplementary Specifications.

At each site, the Plans define and indicate the Common Structure Volume which applies to all alternates, proprietary and non-proprietary.

Under this Section, work shall include construction of the wall complete, together with all other appurtenant items of construction within the Common Structure Volume (CSV) designated on the plans, including, but not necessarily limited to, removing existing structures, excavation and embankment, leveling pads, footings, special backfill materials, underdrain pipe and stone pockets, impervious membrane, temporary sheeting, copings, piles, pile driving equipment, and drainage items. Where reinforced concrete parapets are part of the wall, construction shall include epoxy-coated reinforcement, bridge chain-link fence,

noise barrier, embedded rigid metallic conduit, and junction boxes for roadway lighting facilities.

For the disposition of excess excavation materials within the Common Structure Volume, the provisions of Subsection 202.03 shall apply.

Final design of alternate retaining walls shall be submitted as Working Drawings in accordance with Subsections 104.08, 432.04 and 433.04.

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#### **440.02 MATERIALS AND METHODS OF CONSTRUCTION**

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All materials, methods of construction, and other work pertaining to reinforced concrete cantilever walls shall conform to Sections 401.

All materials and methods of construction pertaining to construction of proprietary wall alternates shall conform to the applicable provisions of Section 432 for mechanically stabilized earth walls and of Section 433 for prefabricated modular walls.

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#### **440.03 WORKING DRAWINGS**

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According to the provisions of Subsection 104.08, final design of alternate retaining walls shall be submitted for approval as shop drawings. Additionally, final designs shall conform to the current AASHTO LRFD Bridge Design Specifications and to Subsections 432.04 and 433.04 of the Supplementary Specifications. The shop drawings shall include detailed computations and all details, dimensions, and quantities necessary to construct the wall. The design and fully detailed plans shall be prepared to Authority standards current at the time of submission and shall be consistent with the Plans.

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#### **440.04 MEASUREMENT**

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Measurement shall be made in accordance with Subsections 432.06 and 433.06 of the (Standard) Supplementary Specifications.

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#### **440.05 PAYMENT**

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Payment will be made under:

<i><b>PAY ITEM</b></i>	<i><b>PAY UNIT</b></i>
Retaining Wall, Location No. ____ .....	Square Foot
Abutment Wall, Location No. ____ .....	Square Foot

Separate payment for excavation, muck excavation, temporary sheeting, chain link fence, cast-in-place concrete gutters, concrete leveling pad, concrete wall panels, panel connections, barrier parapets, lighting standard bosses, moment slabs, reinforcement steel, epoxy coated reinforcement steel, impervious membrane, concrete penetrating sealer treatment, and concrete core sampling will not be made.

Payment for stripping of topsoil will be made in accordance with Subsection 202.05.